

## **Meeting Expanding Needs to Collect Food Intake Specificity: The Nutrition Data System for Research (NDS-R)**

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## **Abstract**

Food and nutrient databases are populated with data obtained from a variety of sources including USDA Reference Tables, scientific journals, food manufacturers and foreign food tables. The food and nutrient database maintained by the Nutrition Coordinating Center (NCC) at the University of Minnesota is continually updated with current nutrient data and continues to be expanded with additional nutrient fields to meet diverse research endeavors. Data are strictly evaluated for reliability and relevance before incorporation into the database; however, the values are obtained from various sources and food samples rather than from direct chemical analysis of specific foods. Precise nutrient values for specific foods are essential to the nutrition program at the National Aeronautics and Space Administration (NASA). Specific foods to be included in the menus of astronauts are chemically analyzed at the Johnson Space Center for selected nutrients. A request from NASA for a method to enter the chemically analyzed nutrient values for these space flight food items into the Nutrition Data System for Research (NDS-R) software resulted in modification of the database and interview system for use by NASA, with further modification to extend the method for related uses by more typical research studies.



## **Introduction**

Food and nutrient software databases are most often populated with data that are obtained from a wide variety of sources. Food and nutrient database developers are constantly challenged to remain comprehensive and current with the marketplace. Basic nutrient and ingredient information are provided on a food product's Nutrition Facts panel; however, many research endeavors require nutrients of interest far beyond those supplied by the manufacturer. Additionally, nutrition information for a food product may require ongoing updates. Reformulation during the life cycle of the food product can be a continuing process to enhance flavor, improve product performance, reduce cost, etc. (Tobelman, 2001). Regional differences in recipe ingredients comprising mixed dishes, and cultural influences of immigrant groups introducing foods new to a region may introduce further complexity in the capture of specificity required for research data collection. Consequently, the ongoing update and maintenance of food and nutrient databases is of a complex and arduous nature also involving policies and procedures that keep the database size and format manageable (Schakel, 2001).

The Nutrition Coordinating Center (NCC) at the University of Minnesota has developed and maintains a comprehensive and current food and nutrient database that has been widely utilized by the nutrition research community for studies involving dietary intake data collection and nutrient analysis. The database is linked to an interview system that permits direct entry of dietary intake data and immediate, automatic calculation of nutrient values as the data are entered. The Nutrition Data System for Research (NDS-R) dietary intake collection and nutrient analysis software has been designed chiefly for use by researchers studying relationships between diet and health (Buzzard et al., 1995).



The following case study describes a request made by the National Aeronautics and Space Administration (NASA) for a modification of the NDS-R to provide a method for entry of specific food items using chemically analyzed nutrient values. The resulting modification in NDS-R provided features and functionality that were then further expanded to permit application by more typical nutrition research users to input known nutrient data into the NDS-R for intake analysis purposes.

### **NASA Feature and Functionality Requirement**

NASA's operational and research protocols require chemical analysis of space foods to determine nutrient content. This is important for assuring accuracy of menu planning and assessment of actual dietary intake. The chemical analyses are completed by the Johnson Space Center Water and Food Analytical Laboratory. As a user of the Nutrition Data System for Research, NASA's Nutritional Biochemistry Laboratory submitted a request to the NCC for a method that would accommodate the entry of chemically analyzed nutrient value data into the NDS-R software. The nutrients of research interest to NASA included many already found within the NDS-R database, as well as several others not currently included within the NDS-R database (e.g., iodine, manganese).

### **Implementation Issues**

The NASA request for a method to enter nutrient values directly into the NDS-R, thereby creating additional food entries to the user's copy of the database, may not have been feasible to implement without several features that already existed within the NDS-R program. Importantly, the existing hierarchical structure of the NCC Food and



Nutrient Database could be modified to accommodate the addition of a nutrient in the format of a food. The hierarchical structure of the database separates foods into categories, and functions to define further and continuing specificity during a food search (Feskanich et al., 1989). Additionally, the NDS-R interview program included amount information expressed in the many units in which a food might be reported, such as shape, volume, weight, and for many, a food specific unit that would be reported for a particular food, e.g. can, package, each. This feature, with corresponding amount conversion functionality, was fundamental to the entry of amount units commonly used by the manufacturer to express various nutrients. Finally, essential to the implementation of the request was a “user-recipe feature” already in place within the interview system. This feature was originally included within the NDS-R to allow the user to expand the existing database with the addition of unique recipes with the ability to retain those recipes as a “user database” for repeated use. Foods stored within this user database are separate from the NDS-R database, but can be searched, selected and inserted into intake records, or used as an ingredient in another recipe. Such user-entered foods and their nutrient values are displayed in all reports and output files generated for analysis purposes. Although these features provided a foundation that was essential for entering foods using their chemically analyzed nutrient values, some critical modifications to the NDS-R program and the database were also required.

### **Required Modifications**

To allow nutrients to be added as foods to the database, a special nutrient hierarchy (Figure 1) of the nutrients specifically requested by NASA was added to the NCC Food and Nutrient Database. Categorical descriptions of nutrients were also added



to define further specificity and narrow the selection during the nutrient search and to permit these nutrients to be searched within the database like a food (Figure 2). Each nutrient added was assigned a unique food identification code (FID). The unit amounts required to enter each specific nutrient were incorporated into the amount entry selection lists. When a nutrient could be expressed in more than one unit (milligrams, grams, International Units), all corresponding units were added.

In some instances, the nutrient or food component chemically analyzed by NASA did not exist in the NCC Food and Nutrient Database. For those items, blank fields were added to the database to function in a place holding role. These blank fields were titled “user nutrients” and were assigned consecutive numeric labels to allow nutrients and/or food components not available in the database to be entered (Figure 3). Each blank labeled user-nutrient field was also assigned a unique food identification code to permit tracking of the entry in reports and output files for analysis purposes. A note field linked to the nutrient or food component entry permits specific labeling of the unique nutrient field (Figure 4). Currently, the NDS-R program will accommodate entry of 20 nutrients or food components not found in the database.

### **Adaptation for Typical Research Use**

The upsurge in nutraceuticals and functional foods recently novel to the marketplace, and the addition of nutrient fortification to common foods, has further escalated the challenges of food and nutrient database developers to remain comprehensive and market reflective. Additionally, intake of nutrient supplements has been more widely advocated and products have been widely prescribed for use in a number of nutrition-related health conditions. The diverse nature and large number of



dietary supplements on the market have challenged researchers interested in capturing dietary supplement use in dietary intake records. Furthermore, manufacturers' use of fortification altering specific brands of many common foods has further complicated database update and maintenance, in turn, affecting ability to accurately portray reported dietary intake.

Following the completion of the described database enhancements requested by NASA, the Nutrition Coordinating Center began work to add all NCC Food and Nutrient Database nutrients and food components into the food database hierarchical structure. The addition of nutrients and food components found within the database permits known nutrient and food component values, such as those found in nutrient supplements and fortified foods, to be entered into the interview system user-recipe record format by selecting the nutrient hierarchy and, if needed, the user nutrient fields. Dietary supplements and fortified foods entered into the software using this feature are stored within projects in the user's database copy and may be readily accessed for future use in the collection of dietary intake data. User-entered items inserted into dietary intake records are displayed in all record reports and output files for nutrient analysis.

## **Conclusion**

Food and nutrient database developers are continually challenged to remain comprehensive and current with the marketplace. The dynamic nature of the food market has been further complicated by increases in numbers and types of foods fortified by manufacturers and the increased use of dietary supplements. Flexibility in database features and functionality that permit the user to enter known nutrient values for fortified foods and dietary supplements, as well as readily access such entries for future use can

serve to effectively facilitate the collection of food intake specificity for research investigations.

## References

Buzzard, I.M., Schakel, S.F., and Ditter-Johnson, J. (1995). Quality control in the use of food and nutrient databases for epidemiologic studies. In *Quality and Accessibility of Food-Related Data: Proceedings of the First International Food Data Base Conference* (H. Greenfield, Ed.), pp. 241-252. AOAC International, Arlington, VA.

Feskanich, D., Sielaff, B.H., Chong, K., and Buzzard, I.M. (1989). Computerized collection and analysis of dietary intake information. *Comput. Methods Programs Biomed.* **30**, 47-57.

Schakel, S. (2001) Maintaining a nutrient database in a changing marketplace: Keeping pace with changing food products—a research perspective. *J. Food Comp. Anal.* **14**, 315-321.

Tobelman, R. (2001) Implementing calcium fortification: An industry case study. *J. Food Comp. Anal.* **14**, 241-244.



**Food Search**

Search by

☒ Food

☐ Hierarchy

☐ User recipe

Choose Description

What type of ntn was it?

Food Description:

Key	Description	Category
▶NTRN	nutrients ...	nutrients

Limit to:

Figure 1. A hierarchy of nutrients was added to the NCC Food and Nutrient Database.

**Food Search**

Search by

☒ Food

☐ Hierarchy

☐ User recipe

Choose Description

What type of nutrients was it?

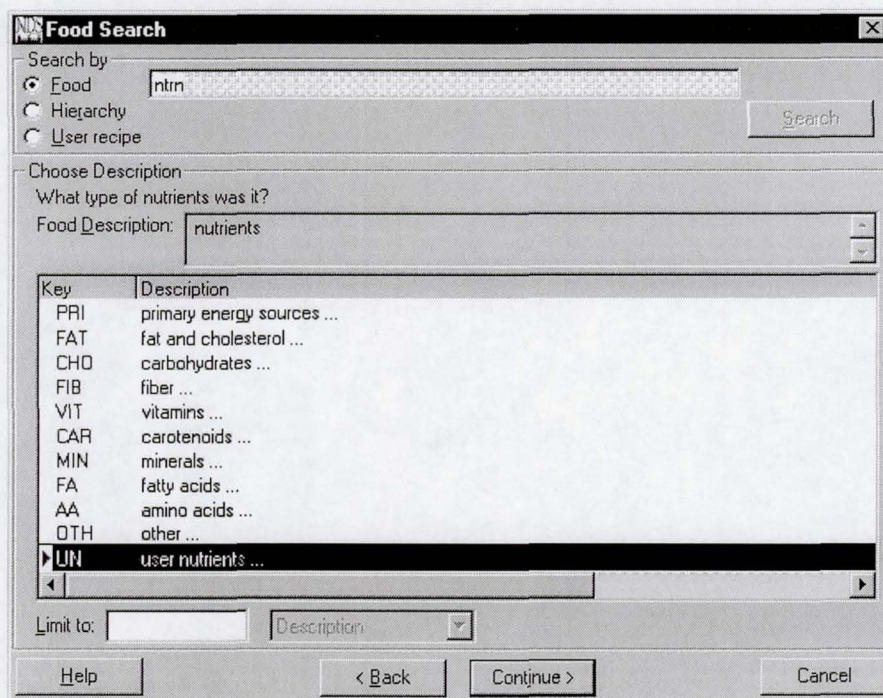
Food Description:

Key	Description
PRI	primary energy sources ...
FAT	fat and cholesterol ...
CHO	carbohydrates ...
FIB	fiber ...
▶VIT	vitamins ...
CAR	carotenoids ...
MIN	minerals ...
FA	fatty acids ...
AA	amino acids ...
OTH	other ...
UN	user nutrients ...

Limit to:

Figure 2. Categories of nutrients were added to provide ability to narrow the nutrient search and allow nutrients to be searched within the database like a food.





**Food Search**

Search by  
☒ Food   
☐ Hierarchy  
☐ User recipe

Search

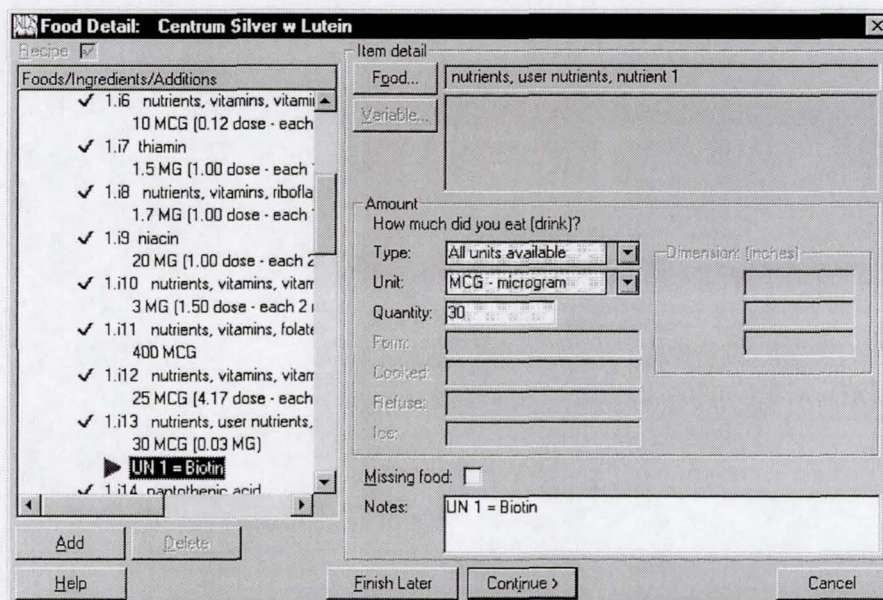
Choose Description  
 What type of nutrients was it?  
 Food Description:

Key	Description
PRI	primary energy sources ...
FAT	fat and cholesterol ...
CHO	carbohydrates ...
FIB	fiber ...
VIT	vitamins ...
CAR	carotenoids ...
MIN	minerals ...
FA	fatty acids ...
AA	amino acids ...
OTH	other ...
<b>UN</b>	<b>user nutrients ...</b>

Limit to:  Description:

Help < Back Continue > Cancel

Figure 3. Blank fields titled “user nutrients” were added to the database to function in a place holding role to allow nutrients and/or food components not available in the database to be entered and tracked.



**Food Detail: Centrum Silver w Lutein**

Recipe ☒ Item detail

Foods/Ingredients/Additions

- ✓ 1.i6 nutrients, vitamins, vitamin 10 MCG (0.12 dose - each
- ✓ 1.i7 thiamin 1.5 MG (1.00 dose - each
- ✓ 1.i8 nutrients, vitamins, riboflavin 1.7 MG (1.00 dose - each
- ✓ 1.i9 niacin 20 MG (1.00 dose - each
- ✓ 1.i10 nutrients, vitamins, vitamin 3 MG (1.50 dose - each
- ✓ 1.i11 nutrients, vitamins, folate 400 MCG
- ✓ 1.i12 nutrients, vitamins, vitamin 25 MCG (4.17 dose - each
- ✓ 1.i13 nutrients, user nutrients, 30 MCG (0.03 MG)
- ▶ **UN 1 = Biotin**
- ✓ 1.i14 pantothenic acid

Add Delete

Item detail

Food...

Variable...

Amount

How much did you eat (drink)?

Type:  Dimension: (inches)

Unit:

Quantity:

Form:

Cooked:

Refuse:

Ice:

Missing food: ☐

Notes:

Finish Later Continue > Cancel

Figure 4. A note field linked to the nutrient or food component entry permits specific labeling of the unique nutrient field